

EXTERNAL STRUCTURES OF HALLER'S ORGAN OF THE IXODES TICK¹

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ABSTRACT

Y. S. Chow and C. H. Wang (1975). *External structures of Haller's organ of the Ixodes tick*. Bull. Inst. Zool., Academia Sinica, 14(1): 9-17. The complex external structures of the Haller's organ on the brown dog tick *Rhipicephalus sanguineus* (Latreille), the green frog tick *Amblyomma testudinarium* Koch and the tropical cattle tick *Boophilus microplus* (Canestrini) were studied by scanning electron microscopy. Both the shape of the opening of the capsule, and the sensilla A₁ of the anterior pit of the first 2 species differed from the last species significantly. Therefore, the potential usage of these characteristics for identification was proposed.

Since Bruce⁽²⁾ first used scanning electron microscopy in the study of Haller's organ of the Lone Star tick, *Amblyomma americanum* (L.), many morphological and histological works, especially the fine structures of the sensory setae on the first tarsi have been reported^(3-6,8). Now, most of the setae-structure of the 1st tarsi of the Lone Star tick have been described in detail, and such investigations are conducted with an aim of providing complete information on all sensilla for future behavioral and electrophysiological studies. In this laboratory, a study on the external structures of the Haller's organ of Ixodes ticks has revealed that both the shape of the opening of the capsule and the sensillum A₁ of the anterior pit were species specific. So this finding possibly will give another new characterization in the future

taxonomy.

MATERIALS AND METHODS

Except the brown dog tick *Rhipicephalus sanguineus* which was obtained from a laboratory culture, adults of tropical cattle tick *Boophilus microplus* and green frog tick *Amblyomma testudinarium* were collected from cattles at the Taiwan Livestock Research Institute, Hsin-Hwa, Taiwan. For scanning electron microscopic observations, legs were cut from the tick and double coated with carbon and gold in a vacuum evaporator. Micrographs were taken with a JEOL JSM-15 scanning electron microscope at an acceleration voltage of 15 KV.

OBSERVATIONS AND DISCUSSION

The distribution of setae in the tarsi of different tick species is not identical. Even in

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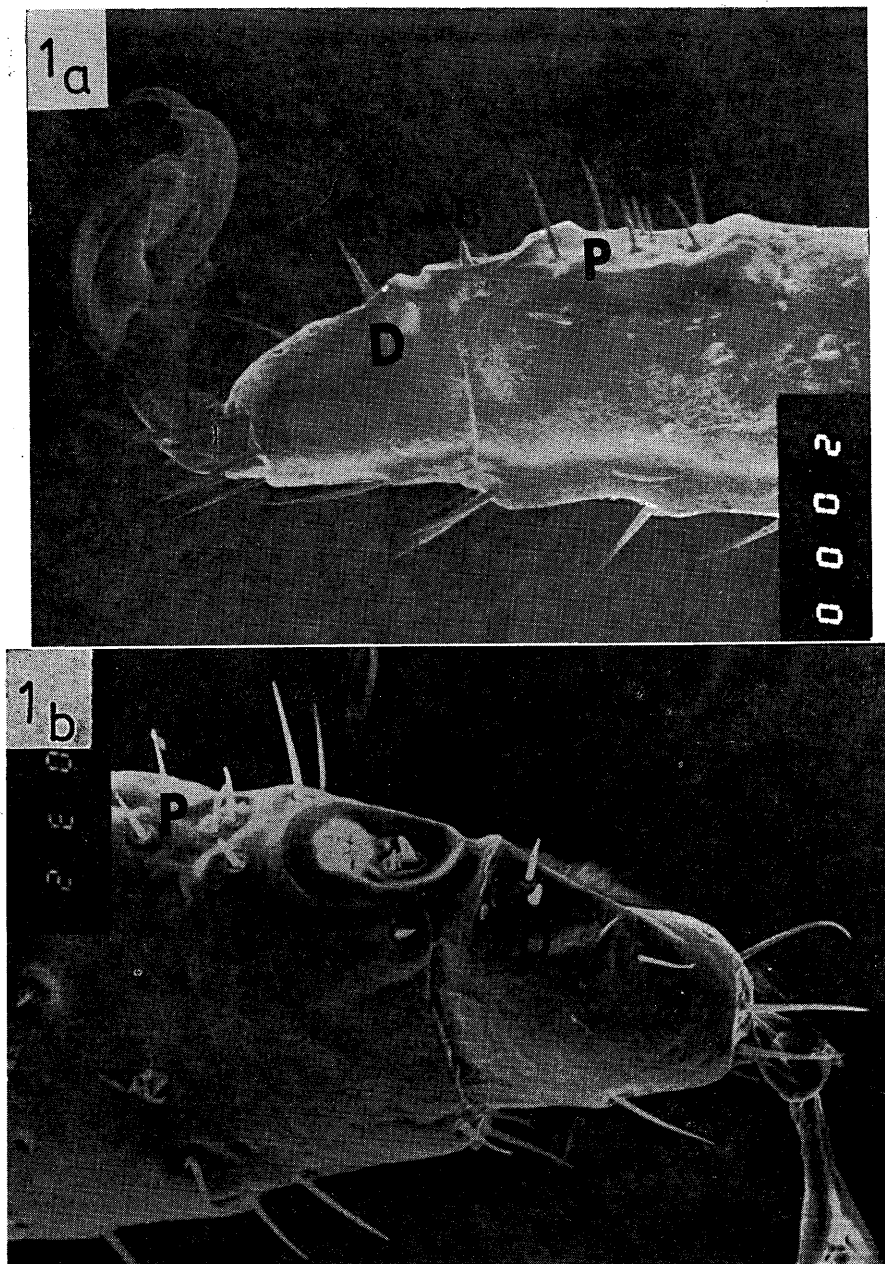


Fig. 1. Scanning electron micrograph of the fourth tarsus (a) and the first tarsus (b) of the brown dog tick *Rhipicephalus sanguineus*, showing the distal bristles (D), anterior pit (AB), posterior bristle (P) and capsule (C). Adult male, 200 \times in a, 300 \times in b.

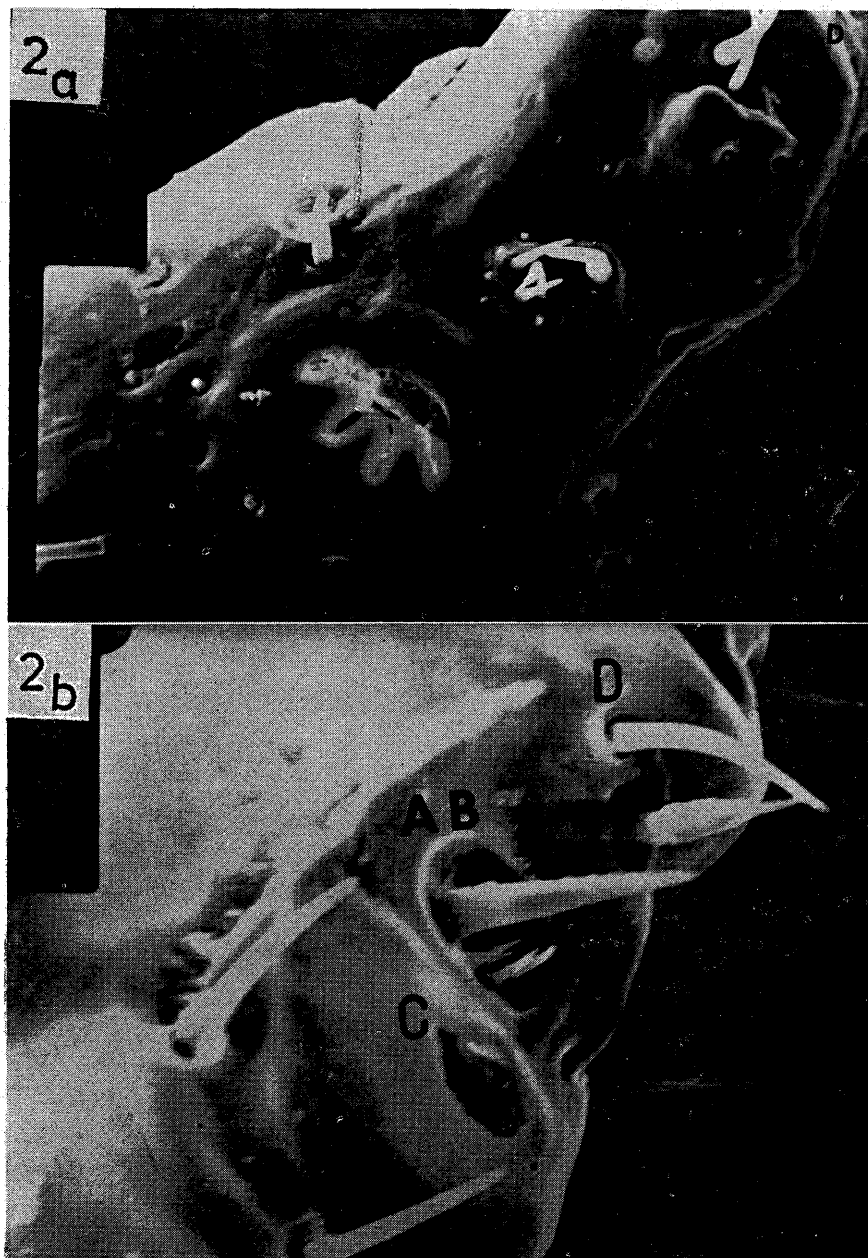


Fig. 2. Dorsal aspects of the first tarsus of the *Amblyomma testudinarium* (a, 600 \times) and the *Boophilus microplus* (b, 1000 \times). Opening of the capsule in *Boophilus* tick is characterized by a round shape. Adult male.

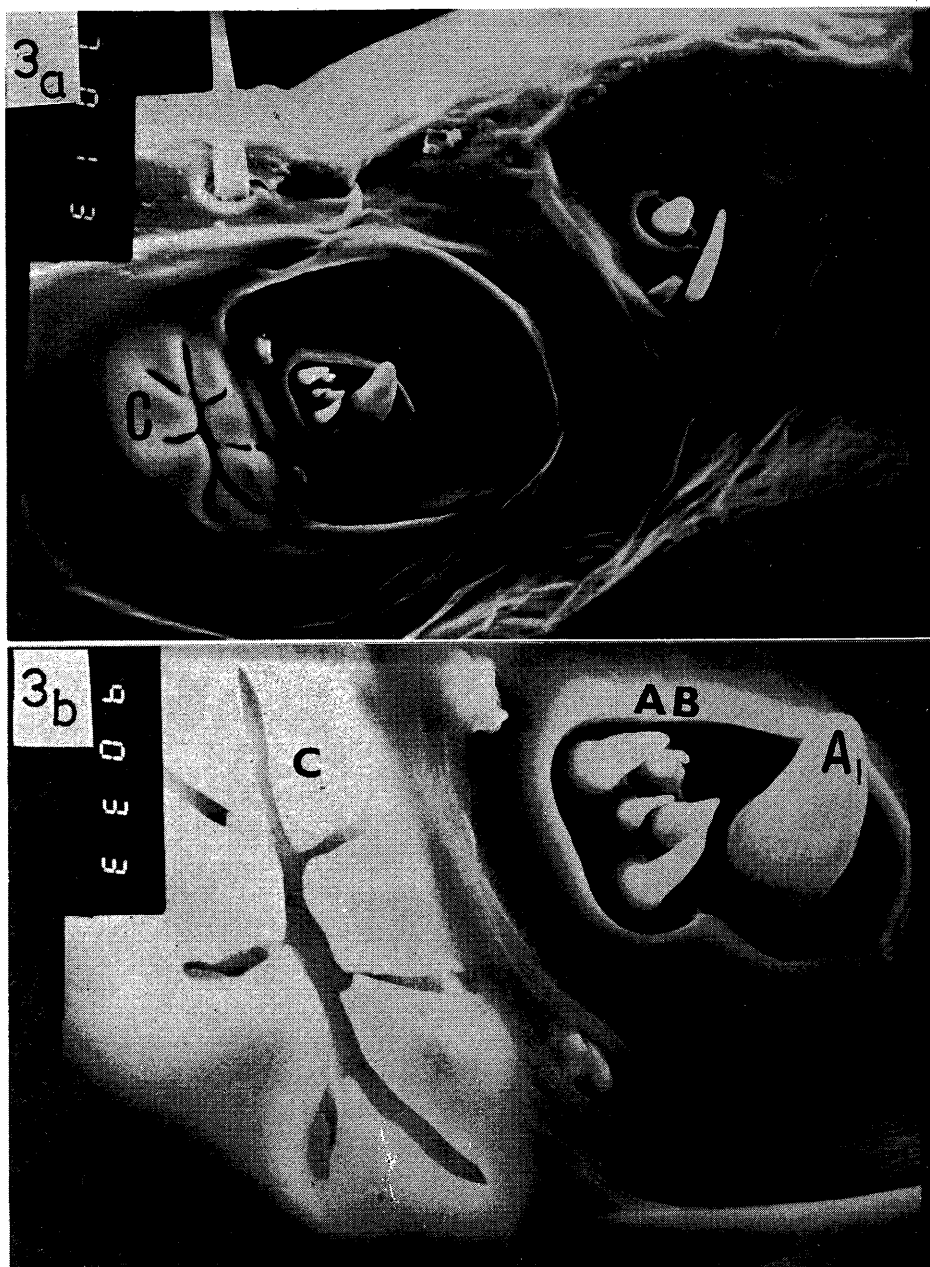


Fig. 3. Detailed external structure of the Haller's organ of the brown dog tick, adult female.

- a. Capsule entrance is characterized as an irregular slit. 1000 \times .
- b. The largest sensillum (A_1) within the anterior pit of the Haller's organ possess plugged pores in their cuticle. 3000 \times

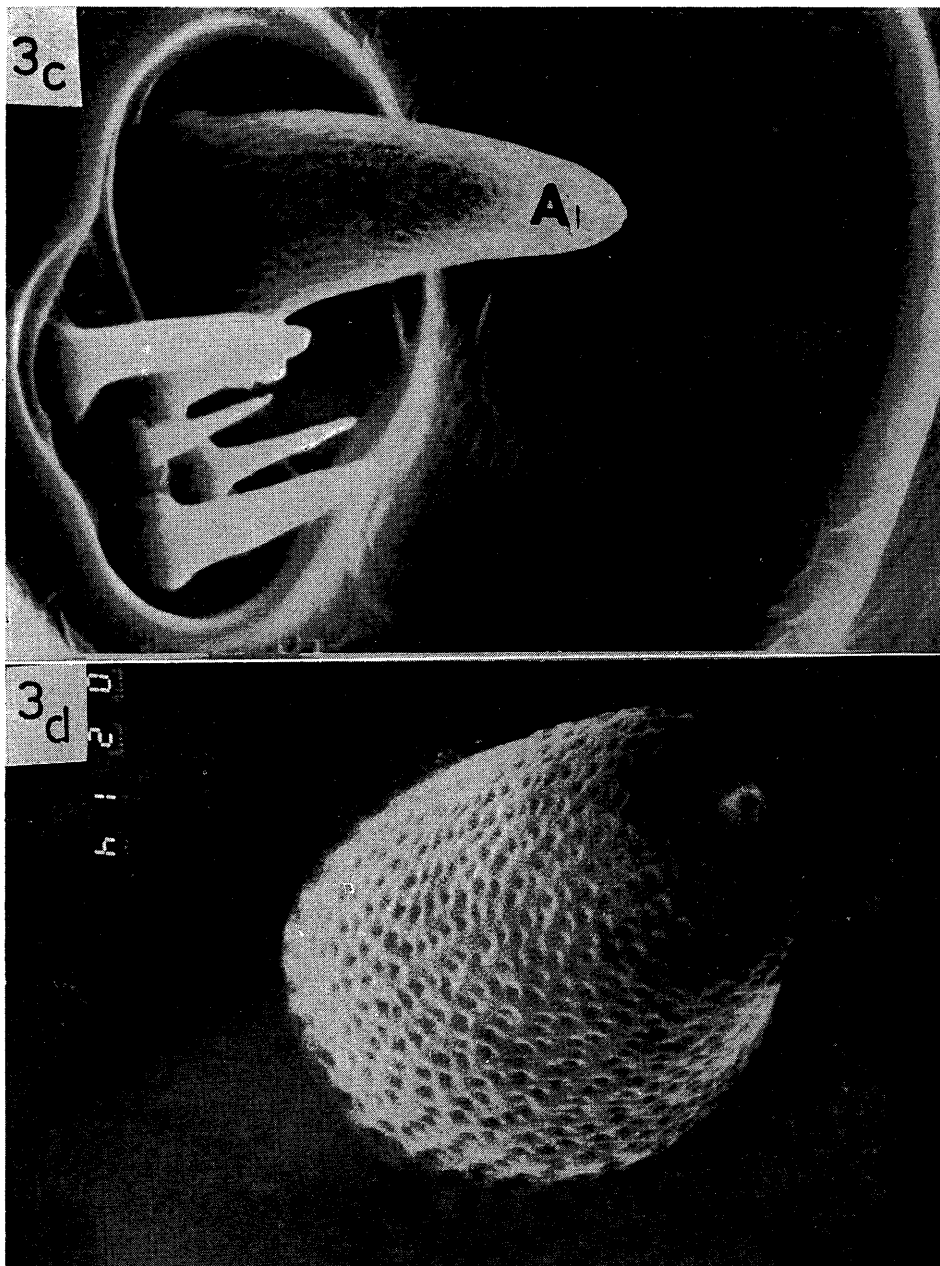
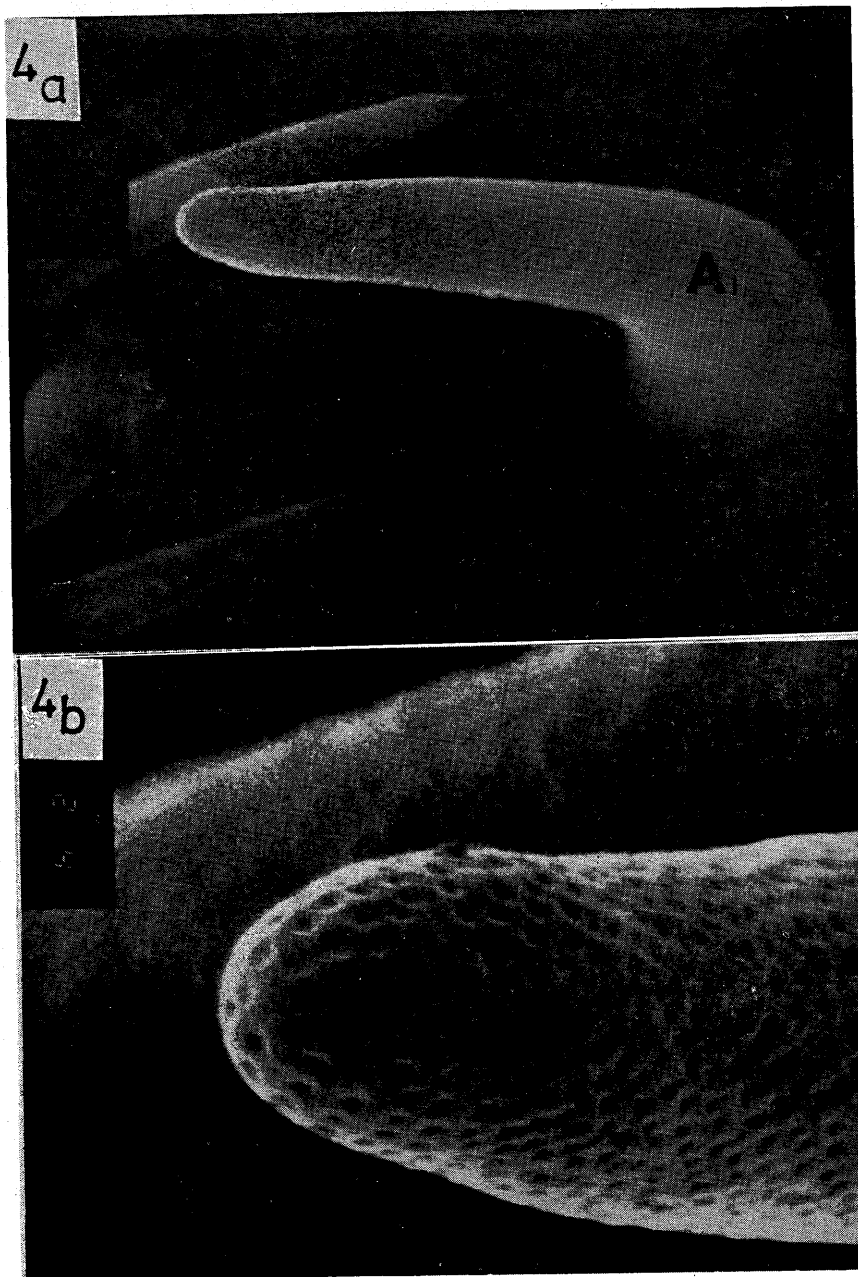


Fig. 3. c. At the top of the sensillum A_1 , there is a bud structure (B). 5000 \times .
d. Same as c, but 1000 \times



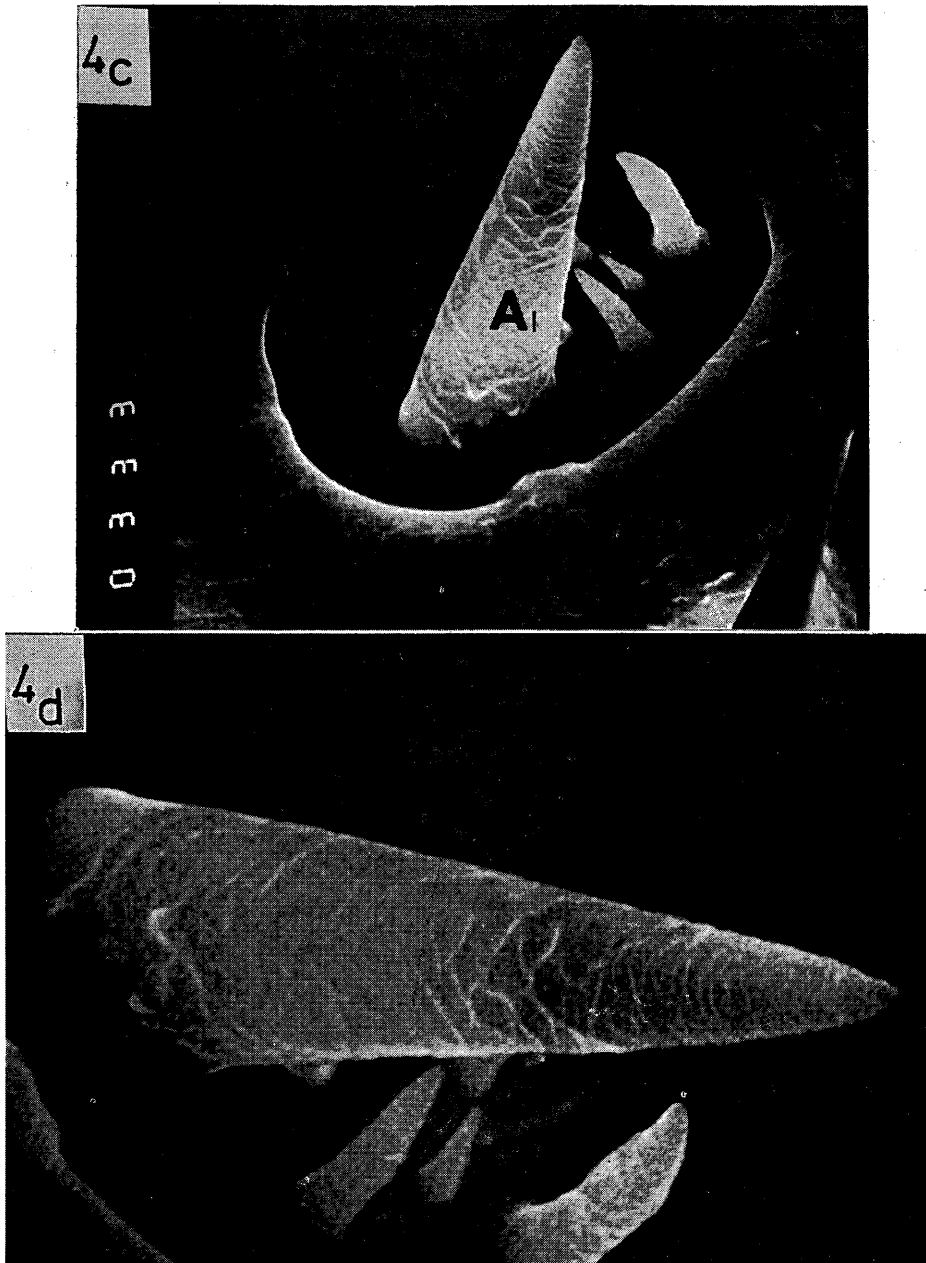


Fig. 4. Enlarged view of the sensillum A₁ of the *Amblyomma testudinarium* (with no bud at the tip. a, 5000 \times ; b, 1000 \times) and *Boophilus microplus* (with no plugged pores in their cuticle, 3000 \times in c; 1000 \times in d).

the same individual tick, the location of associated setae on the first tarsus is different from that of the fourth one (Figs. 1 a and b). As we know, Haller's organ is located only on the dorsal surface of the first tarsus, but not on other tarsi. Axtell *et al.*⁽¹⁾ and Foelix & Axtell⁽⁶⁾ described the Haller's organ in the tick *A. americanum* which composed of a distal bristle group (the anterior pit), and a proximal "capsule" enclosed with several sensilla. Although Axtell *et al.*⁽¹⁾ reported that there were 7 anterior pit setae in the nymph and adult of the tick *A. americanum*, we found in this study there were 6 anterior pit setae in *R. sanguineus* (Fig. 1b) and *B. microplus* (Fig. 4c), and only 5 in *A. testudinarium* (Fig. 2a). Among these setae, we could also easily recognize that the largest sensillum (A_1) is species specific. This A_1 seta in the brown dog tick and green frog tick were both blunt-tipped and with evenly distributed pores in their cuticular wall at high magnifications (Fig. 3c, d and 4b). But the two setae were different from each other by the fact that the A_1 of brown dog tick had a rather large bud-like structure at the top whereas the green frog tick did not (Fig. 3d and Fig. 4b). In the other tarsi of the brown dog tick, although they did not have Haller's organ, this A_1 sensillum was always present (Fig. 1a). In tropical cattle tick, A_1 was rather sharper than those in the other two mentioned species, and it did not possess pores (Fig. 4c and d). Lees⁽⁶⁾ postulated that the anterior pit was responsible for humidity perception, and by using transmission electron microscopy, Foelix and Axtell⁽⁶⁾ had proved its function as a chemoreceptor. When we behaviorally assayed the sex pheromone 2, 6-dichlorophenol with unmated male, the responses of the brown dog tick and the green frog tick were apparently much stronger than that of the tropical cattle tick (Chow, Y. S. unpublished data). This may infer that A_1 is also involved in olfactory sense besides hydrotaxis.

External structures of the capsule were

characterized by a horizontal slit or aperture at the center of the thin membranous cuticle which covers the capsule. In the tick *A. americanum* (L.), a basic rectangular slit aperture was found,⁽²⁾ and in the adult tick *Argas arboreus* Kaiser, Hoogstraal and Kohls, the roof of the capsule is perforated by many pores and a central aperture.⁽⁸⁾ In this study, irregular slit aperture was found in both tick, *A. testudinarium* and *R. sanguineus* (Fig. 3a and b). *Boophilus* tick, instead of a slit, a round-shaped opening was found (Fig. 2b). Since all these external structures of Haller's organ were species dependent on all Ixodes ticks examined, a key was proposed to help future identification.

1. The capsule surface of the Haller's organ is characterized by one common opening and A_1 sensillum of anterior pit is of normal spine shape (Hard ticks).....2

The capsule surface of the Haller's organ is perforated by many pores and A_1 sensillum of anterior pit (referred as d_1 by Roshdy *et al.*)⁽⁸⁾ is serrated on one side (Soft ticks).
..... *Argas arboreus*.

2. Opening of the capsule of the Haller's organ is round shape and sensillum A_1 has no pores on its cuticular wall.

..... *Boophilus microplus*.

Opening of the capsule of the Haller's organ is slit like and sensillum A_1 has pores on its cuticular wall.3

3. Slit aperture rectangular shape.....

..... *Amblyomma americanum*.

Slit aperture irregular shape.4

4. Sensillum A_1 of the anterior pit with bud structure at the tip.

..... *Rhipicephalus sanguineus*.

Sensillum A_1 of the anterior pit without bud structure at the tip.

..... *Amblyomma testudinarium*

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壁蝨前足之海勒感覺器之外部形態

周延鑫 王重雄

本文報導利用掃描電子顯微鏡研究褐狗壁蝨，綠蛙壁蝨及熱帶牛壁蝨的海勒感覺器的外部構造。由放大後的電子顯微圖片知道，前面兩種壁蝨的感覺器和後一種壁蝨不同。所以可以利用這些外部構造的特徵，將來做為分類學的參考。